Ruggedization of COTS Equipment

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Ruggedization of COTS Equipment

- Definition of COTS
  - Many ideas exist on this, but simply stated it is any equipment that does not have a TSO or is not manufactured under PMA
- Some equipment is made for aircraft but does not carry a TSO or PMA
  - Examples are galley equipment manufactured by TIA, entertainment equipment manufactured by Airshow and radio equipment manufactured by Wulfsberg

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- This equipment made for aircraft but without TSO or PMA usually has some amount of DO-160 testing performed on it
- Issues with this equipment are the manufacturing process, the inspection process, and the design change control process

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Installation of “Office Equipment” in aircraft

Introduction

- We took on a project in our DAS to certify the installation of digital-type office equipment in a 747 aircraft
- This equipment included, but was not limited to:
  - A firewall
  - A router
  - A KVM switch
  - A terminal server

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- This equipment was made entirely for the office environment
  - Some of it used plastic packaging
  - No environmental qualifications
  - No good means to secure it in place
  - It was truly “off the shelf” electronics

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- Considerations for the equipment
  - Would be non-essential non-required equipment
  - Would be installed racks and consoles which would be considered to be in occupied compartments
  - Would not be tied into any essential equipment or powered by any essential power

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- Considerations (cont.)
  - We had DAS ARs in 3 disciplines consider the environmental and safety aspects of installing this equipment
    - Structures AR considered
      - crash safety
      - vibration
    - Mechanical Systems AR considered
      - temperature/altitude
      - fire protection
      - vibration

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- Considerations (cont.)
  - DAS ARs (cont.)
    - Electrical Systems AR considered
      - EMI/EMC

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Installation of "Office Equipment" in aircraft Requirements

- Two basic methods for installation were considered
  - Installation in closed racks with separate ventilation and smoke detection
  - Installation in open racks (the option we chose)
- The next step was to impose requirements and then meet with the ACO engineers to formulate an agreement to certify

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- The requirements, once developed, were imposed on our vendors in product specifications
- Requirements
  - Crash Safety DO-160D paragraph 7.3
  - Temp/Alt
    - A temperature survey of the environment was performed during flight
    - Each piece of equipment was evaluated to ensure that it could operate in the measured environment

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- Requirements (cont.)
  - Fire protection
    - A thermal fuse was added in the vicinity of the power supply such that power to the unit would be removed in the event of an overheat condition
  - Vibration DO-160D paragraph 8.7.2 Type 2 aircraft, Category R or R2, Zone 2
  - All plastic grills on exterior replaced with metal
  - EMI/EMC DO-160D paragraphs 21.3 and 21.4 (Categories L and M)

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- Requirements (cont.)
  - The COTS would be purchased as a lifetime buy to include spares
    - The idea is to get parts manufactured in the same time frame
  - The required testing would be done on a single unit ruggedized under the production system of the vendor (as approved by our DAS quality department)
  - EMI/EMC testing would be performed on the 1st, 3rd, and 5th units after ruggedization

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- Requirements (cont.)
  - All units after ruggedization would be identified with a company part number and a serial number
  - All engineering used to produce the part would be maintained as a part of the STC records (in an STC project file)
  - A standard on-aircraft EMI/EMC test would be performed during the TIA process

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- Meeting with the ACO
  - Requirements and specifications were presented to the ACO as a prerequisite to a Program Notification Letter (including cert plan)
  - Some additional considerations were discussed
    - After mod, this equipment was no longer COTS; it would be aircraft grade equipment of commercial origin

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- ACO Meeting (cont.)
  - Considerations (cont.)
    - The on-aircraft EMC ground test will include the use of a spectrum analyzer to determine the EME changes while the new equipment operates
    - Equipment safety under “blade out” conditions is to be addressed

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FIREWALL BEFORE

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FIREWALL AFTER

Ruggedization of COTS Equipment

ROUTER BEFORE

Ruggedization of COTS Equipment

ROUTER AFTER

Ruggedization of COTS Equipment

KVM SWITCH BEFORE

Ruggedization of COTS Equipment

KVM SWITCH AFTER

Ruggedization of COTS Equipment

TERMINAL SERVER BEFORE

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TERMINAL SERVER AFTER

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- Conclusions
  - True COTS equipment requires either repackaging or special installation to become aircraft grade equipment
  - Lay out requirements early in the process
  - Meet with the ACO early in the process
  - Impose clear and specific requirements on the repackage vendors

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QUESTIONS

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COMMENTS

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